## REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

### I. Introduction

Applicants confirm the election of Group 1, claims 1-26. Non-elected claims 27-32 are requested to be cancelled without prejudice of disclaimer. Claims 1, 8, 9 and 23-26 are currently being amended. Claims 33-60 are being added. After amending the claims as set forth above, claims 1-26 and 33-60 are now pending in this application. Support for the amendments and the new claims may be found throughout the specification, such as in original claims 5-9, in Figures 3a-3e, and on page 8, lines 8-27, page 9, line 27 to page 11, line 27, page 14, lines 1-9, page 17, line 20 and page 18, lines 5-25. No new matter was added.

Applicants appreciate the courtesy extended by the examiner in conducting a personal interview with Professor Roukes and the undersigned representative on June 7, 2005. During the interview, the following issues were discussed.

### II. Allowable Subject Matter

Applicants appreciate the indication that claims 5-10 would be allowable if rewritten in independent form to overcome the section 112 rejection. In response, new independent claims 37 and 47 have been added. Claim 37 generically recites the embodiment recited in allowable claim 5. Claim 47 generically recites the embodiment recited in allowable claim 6. Support for claims 37 and 47[1] is provided in Figures 3a, 3b, and 3d-3f and on pages 9-11 of the specification, for example.

[1] Applicants note that the term "substrate" in claims 37 and 47 is not limited to just a wafer or other support which supports the resonator from below. The term "substrate" includes any feature which supports the

As discussed during the interview, these claims are believed to be in condition for allowance. Applicants respectfully submit that claim 37 is in condition for allowance at least for the same reason as claim 5 and that claim 47 is in condition for allowance at least for the same reason as claim 6. New dependent claims 40-46 and 48-52 are submitted to be in condition for allowance at least for the same reasons as independent claims 37 and 47 from which they depend.

## III. 112 Rejections

Claims 1-26 were rejected under section 112, paragraph 2 as being indefinite. In response, claims 1, 8-9 and 23-26 have been amended to overcome the rejection. Specifically, the last paragraph of claim 1 has been amended to recite a molecular binding event to correspond to the molecular detection ability recited in the preamble of claim 1.

## IV. Prior Art Rejections

Claims 1-26 have been rejected under sections 102 and 103(a) as being unpatentable over Charych, Thundat and Fritz. These rejections are respectfully traversed.

Claim 1 has been amended to recite a detector in signal communication with the at least one resonator for measuring a damping of resonance motion of the resonator in response to a molecular binding event on the resonator. New claim 53 recites a similar limitation in means plus function format of section 112, paragraph 6. [2]

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biofunctionalization (i.e., the receptor or ligand) other than another resonator and which strongly restricts the mechanical response of the resonator after the binding event (see page 9, last full paragraph of the specification).

[2] In order to establish a *prima facie* case of unpatentability of a claim containing a section 112 paragraph 6 means plus function element, the examiner must find a prior art element that actually performs the claimed function; it is not enough that the prior art's structure is capable of performing the claimed function when the prior art specifically teaches against performing such a function. *See* MPEP 2183. For example, the predecessor court to the Federal Circuit stated:

> We cannot agree with the board that the [means plus function] claims "merely recite 'a means'." They recite a means plus a function which is not to be found in Leutwyler [the prior art reference]. They therefore do not read on that reference and are not anticipated thereby.

*In re Mott*, 194 USPQ 305, 307 (CCPA 1977). The Federal Circuit cited *In re Mott* with approval in *RCA Corp. v. Applied Digital Data Systems, Inc.*, 221 USPQ 385 (Fed. Cir. 1984). On page 389, footnote 5, the court stated

As requested during the interview, new claim 55 has been added to recite a detector in signal communication with the at least one resonator for measuring a force constant of resonance motion. New claim 59 recites a similar limitation in means plus function format of section 112, paragraph 6.

As discussed during the interview, Applicants believe that based on the description of the devices in the Charych, Thundat and Fritz references, the detectors of Charych, Thundat and Fritz are not adapted to and are not capable of measuring a damping of resonance motion of a nanoscale resonator or a change in force constant of resonance motion due to a binding event between the nanoscale resonator and the modifer, due to the size, configuration and/or detection set up of the devices of Charych, Thundat and Fritz.

As disclosed in the present specification, measurement of the damping or force constant of resonance motion of a resonator is a dynamic measurement which measures properties of a vibrating resonator in response to a molecular binding event on the resonator. In one non-limiting example, binding of molecules to the resonator affects the damping of the resonance motion resonator by the solution. In another non-limiting example, the force constant[3] of the resonance motion is affected by the molecular binding effects which cause the tethering of the resonator to a substrate, to another resonator, or to a large molecule as shown in Figures 3a-3f, for example. Thus, molecular binding events may be dynamically measured.

**A. Thundat and Fritz**

In contrast, the detectors of Thundat and Fritz are not adapted to and are not capable measure damping of a nanoscale resonator or a change in force constant of resonance motion

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> The claims here define the invention in terms of specific "means-plus-function" elements. The limitations which must be met by an anticipatory reference are those set forth in each statement of function. In re Mott, 557 F.2d 266, 269, 194 USPQ 305, 307 (CCPA 1977). Such a limitation cannot be met by an element in a reference that performs a different function, even though it may be part of a device embodying the same general overall concept. [Emphasis added].

[3] Force constant is proportional to one divided by the compliance of the resonator. Thus, measurement of the force constant includes within its scope measurement of compliance of the resonator.

of the resonator, as recited in claims 1, 53 and 55, 59, respectively. The detectors of Thundat and Fritz measure the surface stress on the resonators due to the binding of biomolecules to the resonator. Measurement of the surface stress is a static measurement in which an initial reference position of the resonator is measured and then the deflected position of the resonator is measured (see col. 6, lines 65-68 of Thundat). In other words, the detectors of Thundat and Fritz merely measure the static bending or deflection of the cantilever resonators after the molecules bind to the resonators (i.e., the cantilever resonators are permanently deflected in one direction by the molecules bound to them). This is not a measurement of the force constant.

This is explained in Col. 4, lines 31-41 of Thundat. This portion of Thundat clearly states that the biomolecules produce a stress-induced (i.e., static) deflection of the cantilever 3. This static (i.e., upward) deflection is shown in Figure 1 of Thundat. Furthermore, last paragraph of claim 1 of Thundat states that the deflection is irreversible (i.e., static).

The same static deflection is shown in Figure 2 of Fritz. Furthermore, Figure 3 of Fritz shows the static downward deflection of the cantilever with each separate binding event in intervals I, II and III (it appears that the upward deflection of the cantilever between intervals II and III and after interval III is caused by the purging of the cell with HB). In other words, with each separate binding even in each interval, the cantilever of Fritz statically deflects in one direction (i.e., down), as shown by the curves in Figure 3 of Fritz.

These prior art detectors are different from the claimed detector which detects the properties of the resonance motion of the resonator (i.e., back and forth resonance motion) in response to a binding event, as recited in claims 1, 53, 55 and 59 of the present application. Furthermore, with respect to claims 55 and 59, the devices of Thundat and Fritz lack the modifier and the first means, respectively, recited in these claims.

**B. Charych**

Charych does disclose actuating a beam at its mechanical or electrical resonance and then measuring a difference between the resonant frequency of the beam with the attached biomolecules from a reference beam (see pages 10-11 of Charych). However, Charych does

not disclose or suggest detecting the damping or a change in force constant of resonance motion of a nanoscale resonator, as recited in claims 1, 53 and 55, 59, respectively.

Specifically, Charych measures the resonance frequency, which in effect is a measurement of the inverse distance between the peaks in a plot of vibration amplitude versus time. As noted on page 11, lines 1-5 of Charych, the measured change in frequency is used to detect the change in the mass of the resonator due to the binding of the biomolecules, rather than to detect damping or force constant.

The measurement of resonance frequency is not an inherent detection of damping of claims 1 and 53. For example, detection of damping involves measurement of the decay of vibration amplitude versus time. A nanoscale device is believed to operate in the Q of about one or less than one range (the critically damped or over damped regime). In contrast, the device of Charych is envisaged to be a microscale device rather than a nanoscale device (see page 7, lines 20-22 and Figure 11a of Charych), and the microscale device typically operates in a $Q > 1$ range. Thus, the detector of Charych measures the resonant frequency (which for $Q > 1$ is manifested as a peak in a plot of vibration amplitude versus frequency response) to measure the resonator mass change and the detector of Charych is not adapted to measure damping of a nanoscale resonator.

The measurement of resonance frequency of a microscale resonator of Charych is also not an inherent detection of the change in force constant of a nanoscale resonator of claims 55 and 59. In a fluid reservoir, a binding of biomolecules to a resonator usually would change both the spring constant and the effective mass of the resonator. Thus, since resonant frequency is a function of both spring constant and effective mass, the change in force constant is not inherently determined from the measurement of frequency. In other words, the change in frequency may be due to a change in spring constant, a change in effective mass or a change in both. Specifically, Charych is concerned with measurement of the change in mass of the beam, as noted on page 11, lines 1-5 of Charych, rather than the change in force constant. Furthermore, with respect to claims 55 and 59, the device Charych lacks the modifier and the first means, respectively, recited in these claims.

Thus, claims 1, 53, 55 and 59 are believed to be patentable over Charych.

## V. Conclusion

Applicants submit that the application is now in condition for allowance. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date 6/9/05 By _____

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